

17. The Comparative Anatomy of the Tongues of the Mammalia.—III. Family 2. Cercopithecidae: with notes on the comparative physiology of the tongues and stomachs of the Langurs. By CHARLES F. SONNTAG, M.D., F.Z.S., Anatomist to the Society.

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(Text-figures 16-36.)

CONTENTS.

	Page
Introduction	277
Genus <i>Presbytes</i>	278
Genus <i>Colobus</i>	282
Genus <i>Cercopithecus</i>	282
Genus <i>Macacus</i>	299
Genus <i>Cercocebus</i>	309
Genus <i>Theropithecus</i>	312
Genus <i>Papio</i>	312
Summary and Conclusions	321
Bibliography	321

Introduction.

The papers dealing with the tongues of the Cercopithecidae which have already appeared are divisible into two groups. In the first group are included papers by Mayer (7), Münch (8), Chatin (4), and Tuckerman (11) on the number and arrangement of the vallate papillae, and the taste-buds. In the second group the papers give short accounts of the entire tongue, as part of the description of the anatomy of the whole animal or its alimentary canal; and the best examples of papers of this kind are Flower's "Lectures on the Organs of Digestion of the Mammalia" (5).

Most of these papers have the defect that they state one form of vallate papillary grouping for each tongue. I found, however, that all the different forms of vallate papillae occurring throughout the Cercopithecidae will be found in most species if a sufficient number of examples of each are examined. Consequently, one should qualify each account by a statement that such and such a type occurs in the majority of examples of, say, *Macacus rhesus*, but other types may appear.

The tongues of the Cercopithecidae possess characters which unite them to the tongues of the Cebidae, and separate them from those of the Simiidae. Their vallate papillae, at least in my one hundred and forty-nine examples, are never arranged in the Y-form, as in most of the Simiidae, but adopt the triangular, V-arrangement or double-pair type. The orifices of gland ducts

are more numerous than in the Simiidæ, and the lateral organs possess very different characters. In the Simiidæ, as was shown in my last paper (13), the lateral organs consist either of convex bodies on the sides of the tongue, or of fissures and laminae on the dorsum; in the Cercopithecidæ they consist of rows of fissures and laminae on the lateral borders.

In all the Cercopithecidæ the following structures are absent:—

1. Foramen cæcum.
2. Apical gland of Nuhn or Blandin.
3. Lytta.
4. Plicæ fimbriatæ.

The plicæ may, however, be present in the very young animal (see page 291), and disappear as age advances.

The species of different genera have been arranged in groups, according to their external characters, by Pocock and others, but they cannot be so arranged according to the characters of their tongues. I have arranged my species of *Cercopithecus* according to Pocock's grouping, and it will be seen how the lingual structures vary, sometimes considerably, in each of the groups. As regards classification, I will not go farther than state that the members of the *Æthiops*-group are the only species of *Cercopithecus* in which the vallate papillæ exhibit the double pair type in a pure or unmodified form.

In most tongues the conical and fungiform papillæ exhibit the usual arrangement in clusters and rows of varying degrees of obliquity, and the conical papillæ have the usual distribution according to size; their points, as a rule, have the usual direction. The fungiform papillæ stretch across the entire dorsum or are absent from the centre, thereby forming a dorsal bounding zone.

Genus PRESBYTES (= SEMNOPITHECUS).

THE PURPLE-FACED LANGUR (*P. cephalopterus*).

Habitat: Ceylon.

Measurements.—Total length 3·7 cm.; length of the oral part 3 cm.; length of the pharyngeal part ·7 cm.; width between the lingual attachments of the palato-glossal folds 1·4 cm.; width of the anterior part 1·5 cm.; thickness in the vallate area 1·1 cm.; thickness of the apex ·2 cm.

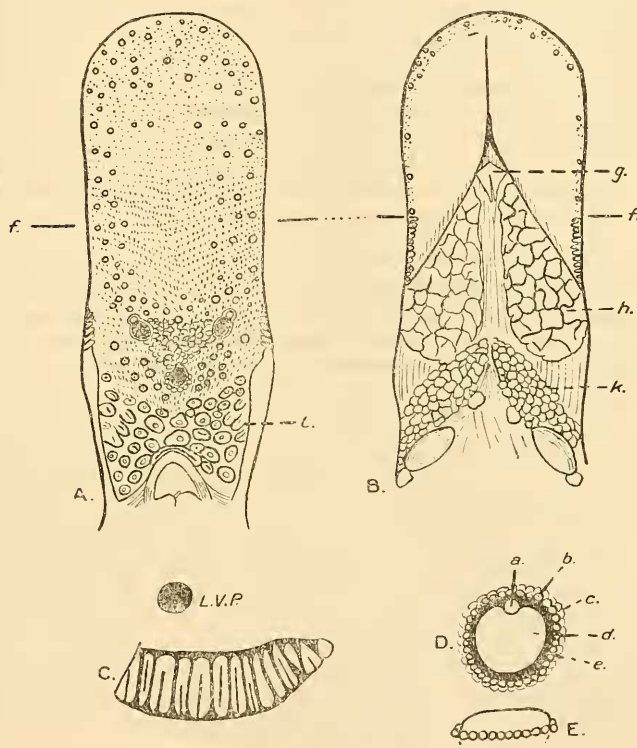
The spatulate tongue has a flat *apex*; the latter is devoid of a notch, and is covered by small conical and fungiform papillæ, but the latter are not numerous. The *lateral borders* are rounded, and have papillæ disposed in the usual manner. The fungiform papillæ thereon are neither numerous nor prominent. They also lodge the lateral organs, which are well-developed, thus agreeing with the description of Boulart and Pilliet (1). The structures mentioned above are absent.

The Circumvallate Papillæ (text-fig. 16 D).

Three prominent, circular, vallate papillæ form an isosceles triangle whose acute vertical angle is directed backwards. All are bluish-black in colour, granular, and have white secondary papillæ at their anterior poles. All the fossæ (text-fig. 16 D, *e*) and vallums are well-marked, and the posterior vallum is coarsely nodulated (text-fig. 16 D, *b* and *c*).

The vallate triangle contains several large conical papillæ, and a large fungiform papilla bisects the base.

Text-figure 16.

The tongue of *Presbytes cephalopterus*.

A. Dorsum ; B. Inferior surface ; C. Lateral organs ; D. and E. Plan and elevation of the posterior vallate papilla (*a*, anterior part ; *d*, main part). Other letters in the text.

The Fungiform Papillæ.

The fungiform papillæ form a dorsal bounding zone on which they have the usual arrangement in clusters and rows, but they have not got the usual distribution according to size. The

posterior rows are close together. All are hemispherical, and their surfaces are smooth or granular.

The Conical Papillæ.

The arrangement, distribution according to size, and course of their points follow the usual type, and the interpapillary dorsum appears as narrow lines.

The Lateral Organs (text-fig. 16 C).

The prominent lateral organs extend over the lateral borders from the dorsum to the inferior surface. The primary sulci are deep, and the laminae, which possess secondary sulci, appear as small rods. Each organ is concave towards the lateral vallate papilla of its own side, for the laminae run in different directions. The lateral vallate papillæ (L.V.P.) are level with the posterior laminae. The anterior laminae run upwards and backwards, the middle laminae are vertical, and the posterior laminae run upwards and forwards. The limits of the organs are shown in text-figs. 16 A, *f* and B, *f*. Each organ is 1 cm. long. The right one has 13 laminae and 14 sulci, and the left one has 13 laminae and 14 sulci. At the anterior end a small fold of mucosa is seen.

The Frenal Lamella (text-fig. 16 B, *g*).

The triangular lamella has a bifid apex. Its crenated edges run postero-laterally as far as the middle of the lateral organs.

The *median ventral* sulcus is shallow and wide, the *frenum* is of moderate length, and the *ventral papillary zone* is narrow.

Glands and Lymphoid Tissue (text-fig. 16 A, *l*).

The whole of the dorsum, behind and at the sides of the vallate triangle, is covered with white circular or oval areas containing round or slit-like orifices. These glands increase in size from before backwards, and their secretions keep the tongue viscid. They are more developed than in the Cercopithecques, Macaques, Mangabeys and Baboons. The viscosity of the tongue remains for a long period, even in preserved specimens.

These large lingual glands are accompanied by an enormous development of the salivary glands (text-fig. 16 B, *h* & *k*).

The lingual and salivary glands of the Langurs form a larger glandular apparatus than in all other Primates. In the case of the lingual glands ocular inspection and microscopic examination must both be employed to estimate their area.

The Physiology of the Lingual Glands and Stomach.

To understand the significance of the great development of the lingual and salivary glands, one must take into account the nature of the diet, the presence or absence of cheek-pouches, the degree of complication of the stomach, and the size of the cæcum.

The LANGURS have no cheek-pouches, large lingual and salivary glands, a complex stomach, and a cæcum of moderate length. They eat leaves almost entirely.

Owen (13) considers that the first part of the stomach replaces the cheek-pouches. I believe his opinion to be correct and would add that the leaves, mixed with the copious secretions of the lingual and salivary glands, lie in the first part of the stomach till insalivation is completed.

The ANTHROPOID APES have no cheek-pouches, a very high development of the basal lingual glands, and a simple stomach. They eat fruits and shoots which are more succulent than the food of the Langurs, and a complex digestive apparatus is not so necessary.

The CERCOPITHEQUES, MACAQUES, BABOONS and MANGABEYS have cheek-pouches, a moderate degree of development of lingual and salivary glands, and a simple stomach. They live on a succulent diet and store food in their cheek-pouches. A little food can be removed from time to time, insalivated thoroughly and swallowed. I would suggest that cheek-pouches are, consequently, part of the digestive apparatus, and not only store-houses.

In the UNGULATA the process of rumination obviates the necessity for largely-developed lingual glands.

The THREE-TOED SLOTH (*Bradypus tridactylus*) resembles the Langurs in the nature of its diet, but the physiology of the tongue and stomach is different. The tongue is mainly mechanical in function, for its gustatory and secretory organs are small. Prehension is its strongest mechanical action. As the stomach contains many hard, almost entire leaves, mastication and insalivation cannot be very complete. Moreover, there are no cheek-pouches to prolong the stay of the food in the buccal area. Consequently, the stomach must soften the leaves for it gets little assistance from the tongue and salivary glands. It also cannot share the process of digestion with the cæcum. The ruminating gutter running through the stomach takes on the regurgitant function of the oesophagus of the Ruminantia.

In the KOALA (*Phascolarctos cinereus*) there are large cheek-pouches, the lingual glands are well-marked, and the salivary glands, especially the parotids, are large. The stomach is simple and the cæcum enormous. The leaves remain long in the buccal area, in virtue of the cheek-pouches, and can be thoroughly moistened and softened. They then pass to the stomach, but the effect of the peculiar gastric gland has not been worked out. The stomach, however, does not play such an important part as in the Langurs and Sloths, for much of its work is taken away by the enormous cæcum.

These remarks indicate that the cheek-pouches are not entirely storehouses, and show how the functions of the different parts are interdependent. They also demonstrate how a diet of leaves requires a complex stomach and small cæcum, or a simple stomach and a large complex cæcum, for its digestion.

THE ENTELLUS LANGUR (*P. entellus*).

Habitat: India.

The tongue differs from that of *P. cephalopterus* in the following respects:—1. It is thicker. 2. The vallate papillæ are smaller and the posterior vallum is more nodulated. 3. The fungiform papillæ are more numerous. 4. The conical papillæ on the base are larger. In other respects the tongues are similar.

In the Capped Langur (*P. pileatus*) the frenal lamella is a broad bilobed plate.

In the Madras Langur (*P. priamus*) the frenal lamella is triangular and bifid, and the apical vallate papilla is small.

Genus COLOBUS.

Flower (5) has briefly described the tongue of the White-thighed Guereza (*C. vellerosus*) as follows:—

“The tongue is long and narrow, with three large circumvallate papillæ forming the corners of a triangle, with the apex directed backwards; close behind each of the large anterior ones is a smaller one of the same form. At the lower part of the frenum is a short, thick, fleshy salivary papilla, constricted at the base, then dilating, and pointed and bifid at the extremity.”

Flower does not describe the condition of the glands on the base of the tongue, but points out that the salivary glands, especially the submaxillaries, are very large, and he gives measurements. As the diet and stomach closely resemble those of the Langurs, and cheek-pouches are absent in the Guerezas, the physiology of the tongue and stomach is similar to those of the former, which I have described on page 280.

The tongues of the members of the genera *Presbytes* and *Colobus*, as will be shown later, differ from those of the other Cercopithecidae chiefly in the nature of the glands on the base.

Genus CERCOPITHECUS.

The species are here arranged in the groups described by Pocock (9):—

THE ALBIGULARIS GROUP.

Species examined: *C. preussi*; *C. albigularis*.

PREUSS'S CERCOPITHEQUE (*C. preussi*).

Habitat: Cameroons.

The conical tongue has the following measurements:—Total length 5·4 cm.; length of the oral part 4·6 cm.; length of the pharyngeal part 8 cm.; width between the lingual attachments of the palato-glossal folds 2·5 cm.

The *apex* is rounded, and bears many closely-aggregated conical papillæ, and a few small fungiform papillæ. It has no notch. The *lateral borders* are rounded and have the lateral organs at their posterior extremities. The structures mentioned in the introduction are absent.

The Circumvallate Papillæ (text-figs. 17 A & C).

Three papillæ form an equilateral triangle with the apex behind. The two anterior papillæ are smaller than the posterior one, the fossæ are all well-marked, and the vallums appear as clear zones. All are prominent, especially the posterior one, and the surfaces are granular.

Within the vallate triangle there are many large conical papillæ, and a fungiform papilla bisects the base.

Several long sulci and laminae of the lateral organs converge towards the lateral vallate papillæ and end on the outer borders of the vallums. In no other species of *Cercopithecus* is this condition present.

The Fungiform Papillæ.

On the dorsal bounding fungiform zone the papillæ have the usual arrangement, as also on the sides and inferior surface. They are hemispherical or bossed, and the surfaces are smooth or granular. There is no distribution pattern according to size, and the posterior rows are close together. One of them bisects the base of the vallate triangle.

The Conical Papillæ.

The papillæ have the usual arrangement in clusters and rows of different degrees of obliquity.

Appearance.—The papillæ of the oral part are dark grey in colour. All of them appear, to the naked eye, like small nodules. Under a pocket lens they appear surrounded by zones of inter-papillary dorsum (text-fig. 17 D), and have bodies of different shapes, with or without processes.

Glands and Lymphoid Nodules.

Small nodules are present on the base, but no duct orifices are visible.

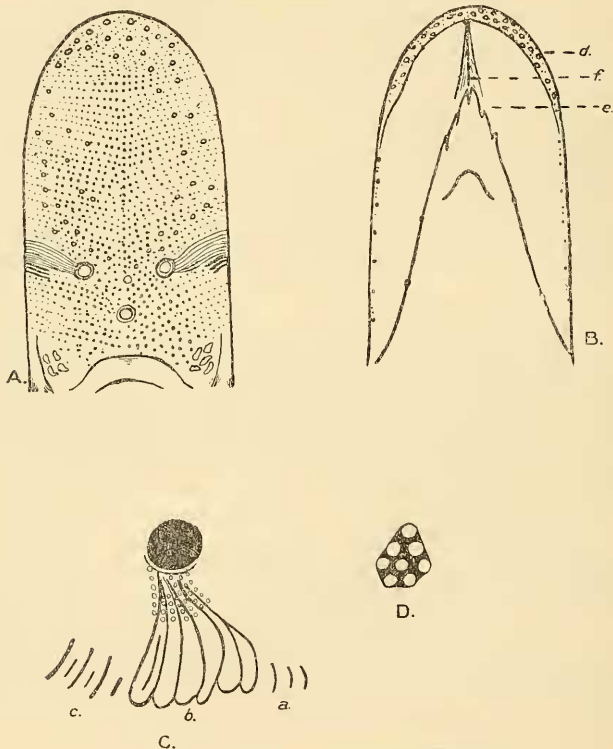
The Lateral Organs (text-fig. 17 C).

The lateral organs begin anteriorly as a number of small ill-defined fissures and laminae (text-fig. 17 C, *a*). These are followed by a series of long tapering laminae and sulci (text-fig. 17 C, *b*) converging towards, and ending on, the vallums of the lateral vallate papillæ, and they are also convex forwards. These are succeeded by a number of laminae separated by sulci which are all parallel to one another (text-fig. 17 C, *c*). Most of the laminae are traversed by secondary sulci. The measurements, etc., are shown as follows:—The right organ is 1.4 cm. long, and has

11 laminae and 12 sulci. The left organ is 1.4 cm. long, and has 9 laminae and 10 sulci.

The *ventral papillary zone* (text-fig. 17 B, *d*) is wide anteriorly and narrow posteriorly, and its papillae have the usual arrangement.

Text-figure 17.



The tongue of *Cercopithecus preussi*.

The Frenal Lamella (text-fig. 17 B, *e*).

The triangular frenal lamella has a bifid apex, and a plain upper surface. Its edges, which extend postero-laterally as far back as the level of the middle of the lateral organs, are fused posteriorly with the under surface of the tongue. They have pointed processes anteriorly and tubercles posteriorly. In no other species of *Cercopithecus* did I find such long, sharp processes.

The *median ventral sulcus* is narrow and deep anteriorly, but widens out posteriorly. It lodges a crest derived from the frenum (text-fig. 17 B, *f*).

In the fresh tongue the vessels on the base were seen, and they

resembled the condition which I have already described and figured for *Macacus* (10).

The outstanding features are, therefore, the great length of some of the laminae of the lateral organs, and the sharp processes on the frenal lamella.

Sykes's *Cercopithecus* (*C. albicularis*) has an entire, oval, undivided lamella (text-fig. 20 D). Owen (15) described a vallate triangle.

THE MONA GROUP.

Species examined: 1. *C. burnetti* (two examples).

2. *C. mona* (two examples).

I did not observe any pigmented forms in this group.

BURNETT'S CERCOPITHEQUE (*C. burnetti*).

Habitat: West Africa.

When the tongues were examined fresh they did not exhibit the vessels running between the base and the vallate papillae.

Measurements.—Total length 3.2 cm.; length of the oral part 2.5 cm.; length of the pharyngeal part .7 cm.; width between the lingual attachments of the palato-glossal folds 1.5 cm.

The *apex* and *lateral borders* are the same as in *C. preussi*, and the same structures are absent.

The Circumvallate Papillae (text-fig. 18 D).

The vallate triangle has an acute or obtuse vertical angle. It lodges many conical and a few fungiform papillae.

The three papillae, especially the posterior one, are prominent, and the latter appears as if it had been pushed through the vallum, thereby stretching it. All are granular, the fossae are well-marked, and the vallums look like clear zones.

The Fungiform Papillae.

The fungiform papillae are the same as in *C. preussi*, but are more numerous at the sides. None are overlapped by conical papillae.

The Conical Papillae.

The arrangement is similar to that of *C. preussi*. Most of them are cylindrical, and each one is surrounded by a zone of inter-papillary dorsum (text-fig. 18 C). Their surfaces are granular, and there are few points.

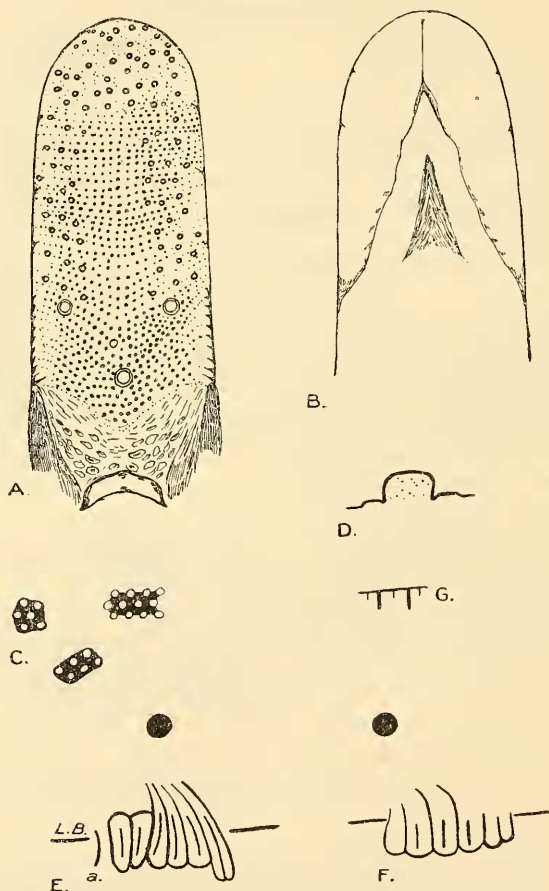
A few *orifices of ducts* are present on the base of the tongue.

The Lateral Organs (text-fig. 18 E, F, & G).

The sulci are narrow, and the laminae lie on both dorsum and lateral borders (L B.) All the sulci and laminae are convex forwards, and secondary grooves traverse the latter. The right organ is .65 cm. long, and has 6 laminae and 7 sulci. The left

organ is .7 cm. long, and has 5 laminæ and 6 sulci. None of them reach near the vallums of the lateral vallate papillæ. False folds of mucosa (*a*) may be present. The laminæ are flat on plan (*G*).

Text-figure 18.

The tongue of *Cercopithecus burnetti*.

The Frenal Lamella (text-fig. 18 B).

The triangular lamella has an entire apex, and its edges are devoid of tubercles and processes.

The *inferior surface* is otherwise similar to that of *C. preussi*.

When the dorsum is examined by the naked eye it has a finely nodulated surface as in *C. preussi*, and the lens reveals how the interpapillary dorsum forms zones round the conical papillæ (text-fig. 18 C).

THE MONA CERCOPITHEQUE (*C. mona*).

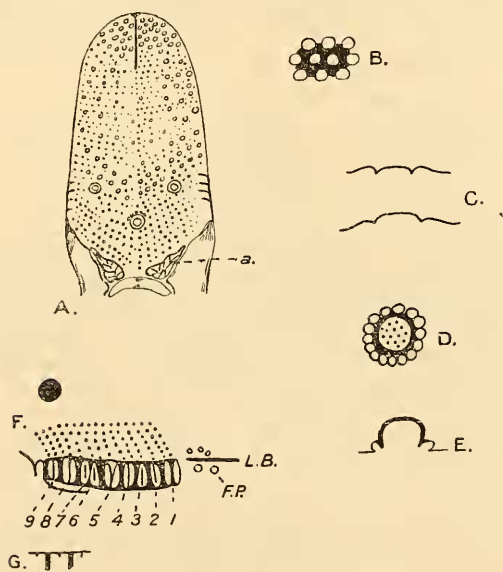
Habitat: West Africa.

The fresh tongues did not reveal the vessels running between the base and the vallate area.

The following *measurements* refer to an adult specimen:—Total length 3.5 cm.; length of the oral part 2.9 cm.; length of the pharyngeal part .6 cm.; width between the lingual attachments of the palato-glossal folds 1.9 cm.

One of my specimens (adult) has an apical notch whence a median sulcus runs back for 1.05 cm., but the young specimen has neither. In other respects, however, the *apex* and *lateral borders* have the same characters, and the lateral parts of the dorsum have the same clusters of fungiform papillae as in *C. burnetti*.

Text-figure 19.

The tongue of *Cercopithecus mona*.*The Circumvallate Papillae* (text-fig. 19 C, D, & E).

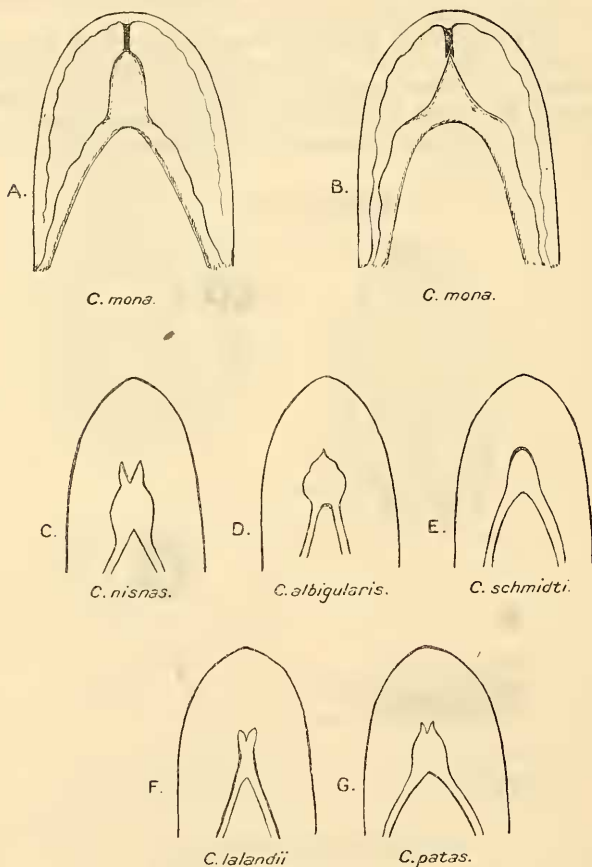
The vallate triangle is isosceles. The three papillae, especially the posterior one, are prominent as in *C. burnetti*. One tongue has a finely-granular posterior vallum, but the latter is coarsely nodular in my other specimen (text-fig. 19 D). Within the vallate area there are more fungiform papillae than in *C. burnetti*. The anterior papillae are oval, but the posterior one is circular.

Münch (8) described a vallate triangle.

The Fungiform Papillæ (text-fig. 19 A & F, F.P.).

On the middle of the oral part of the dorsum the papillæ are small, but those on the lateral parts are large and prominent. The apical cluster contains many large ones. They are hemispherical or umbilicated, and none are overlapped by conical papillæ.

Text-figure 20.



The frenal lamellæ of the Cercopithecus.

The Conical Papillæ.

The conical papillæ have the usual arrangement, but the posterior rows of the oral part of the dorsum are less oblique than in most species of *Cercopithecus*. They are surrounded by zones of interpapillary dorsum (text-fig. 19 B). They also have the usual distribution according to size, and the points run in

the usual directions. The papillary bodies are flat or cylindrical, and the number of points per papilla varies.

Glands and Lymphoid Nodules (text-fig. 19 A, a).

At the sides of the epiglottis there are prominent nodular masses with a few minute orifices of gland-ducts and pits.

The Lateral Organs (text-fig. 19 F & G).

The lateral organs lie on the lateral borders (L.B.) and inferior surface. They consist of short, broad, furrowed laminae separated by short, wide sulci. The laminae do not project (text-fig. 19 G). The right organ is 1.45 cm. long, and has 9 laminae and 10 sulci. The left organ is 1.3 cm. long, and has 7 laminae and 8 sulci.

The Frenal Lamella (text-fig. 20 A & B).

The apex is entire and reaches a point 3 mm. from the apex of the tongue in my adult specimen, and 2 mm. in my young one. It is pointed or rounded. The edges reach as far back as the middle of the lateral organs.

THE PATAS GROUP.

Species examined: *C. patas*; *C. pyrrhonotus*.

THE PATAS CERCOPITHEQUE (*C. patas*).

Habitat: West Africa.

Three specimens were examined, and the following *measurements* refer to the largest one:—Total length 4.8 cm.; length of the oral part 4.3 cm.; length of the pharyngeal part .5 cm.; width between the lingual attachments of the palato-glossal folds 1.9 cm.

In two examples the tongue is yellowish-brown in colour, but in one it is unpigmented. The *apex* and *lateral borders* are similar to those of the preceding forms, except that the apex has a median notch as in *C. mona*. There is no median dorsal sulcus, and the structures mentioned on page 278 are absent.

The Circumvallate Papillae (text-fig. 21 A & F to I).

Three papillary patterns are present in my three examples:—*Specimen No. 1.*—The three vallate papillae form an isosceles triangle with an acute vertical angle. All are prominent, especially the posterior one; they are circular on plan and conical on elevation, the broad ends of the cones projecting beyond the vallums (text-fig. 21 A, H, & F). All have granular surfaces.

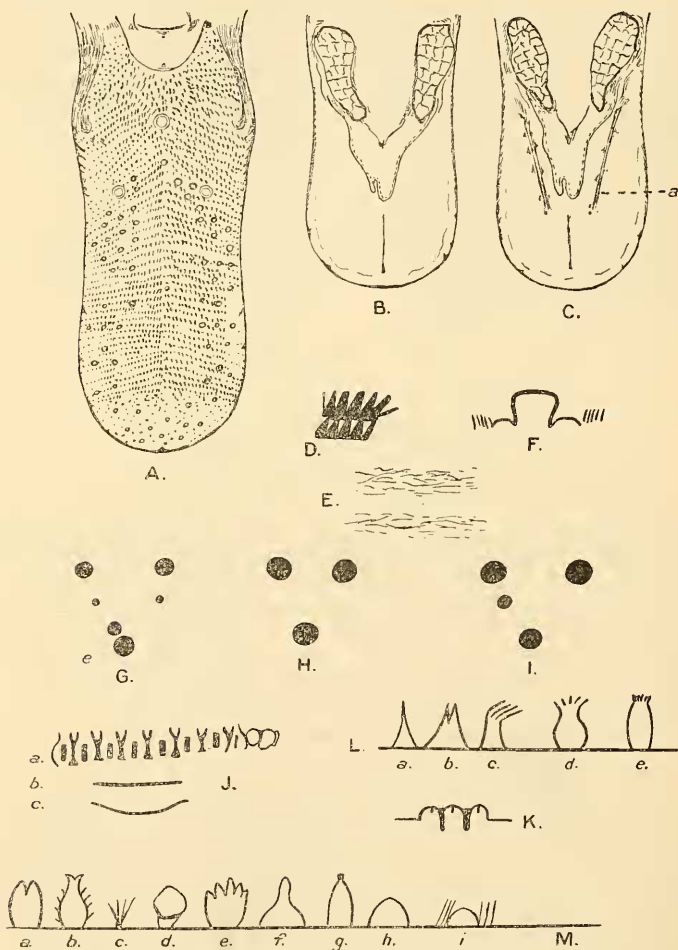
The vallate area contains several prominent fungiform papillae, and is roughened by conical papillae.

Specimen No. 2.—Four vallate papillae form a V. On the left limb, including the posterior papilla, there are three, but the right limb has only two (text-fig. 21 I). The mid left papilla is small.

Specimen No. 3.—Six papillae are arranged in the form of a V, each limb of which has three elements. The most anterior

papilla of each limb is large, and the middle one is small. The left posterior papilla is large, and the right one is small, but both stand on the summit of a common elevation (text-fig. 21 G).

Text-figure 21.

The tongue of *Cercopithecus patas*.

B. Ventral surface of an adult specimen; C. Ventral surface of a young specimen. Other letters in text.

This specimen is an example of a double-pair type greatly modified by the addition of small papillae,

The Fungiform Papillæ.

The fungiform papillæ stretch right across the dorsum, but have the usual arrangement in clusters and rows.

All of them have granular surfaces and are hemispherical, bossed or collared. Those which are included within the vallate area may be mistaken for vallate papillæ, but a careful examination reveals the absence of fossæ and vallums.

There is a variable amount of overlapping or concealment by long conical papillæ (text-fig. 21 M, i), especially in the case of the fungiform papillæ within the vallate triangle where the conical papillæ form prominent processes.

The Conical Papillæ (text-fig. 21 L & M).

The conical papillæ have the usual arrangement in clusters and rows, and their disposition according to size takes the usual form. Their points, however, face in all directions.

Most of them are filiform and make the dorsum shaggy, but not to such an extent as in *C. æthiops*. The points form rows, and between them one can see strips of interpapillary dorsum (text-fig. 21 D & E). The number of points to each papilla varies greatly from one to a brushwork.

The Lateral Organs (text-fig. 21 J, a, b, c, & K).

The appearance presented by the lateral organs differs greatly from those of *C. preussi* and *C. burnetti*. The sulci are wide, so the laminae, which are small and rounded, appear like a row of small oval bodies. Each lamina is traversed from without inwards by a broad, shallow, secondary sulcus, and a row of conical papillæ runs backwards and inwards across the dorsum from the inner end of each ridge. The measurements, etc., are given as follows:—

<i>Organ.</i>	<i>Length.</i>	<i>Laminae.</i>	<i>Sulci.</i>
Right	1.25 cm.	10	11
Left	1.5 „	9	10

The organs may appear as straight rows or curved lines (text-fig. 21 J, b & c).

The Frenal Lamella (text-fig. 21 B & C; 20 G).

The apex is bifid, and the halves taper from a broad base. The plain edges run postero-laterally to the level of the middle of the lateral organs. The points are rounded or sharp, and may or may not be equal in size.

Plicæ Fimbriatæ (text-fig. 21 B & C a).

Plicæ are absent in all my adult specimens, but are present in the young one, so *they may disappear as age advances*. They begin anteriorly at the level of the apex of the free part of the frenal lamella, and run postero-laterally for 1.8 cm. The mucosa

between them is more smooth and polished than that of the rest of the inferior surface of the tongue.

The *median ventral sulcus* contains a median crest, which, however, is narrow.

THE NISNAS CERCOPITHEQUE (*C. pyrrhonotus*).

Habitat: Sudan.

Mr. Pocock's sketch shows an oval lamella with two apical points (text-fig. 20 G). It is very similar to that of *C. patas*.

THE ÆTHIOPS GROUP.

Species examined: *C. ethiops*; *C. sabæus*; *C. tantalus*;
C. rufoviridis.

The only pigmented specimen observed is my young one of *C. tantalus*.

THE ABYSSINIAN CERCOPITHEQUE (*C. ethiops*).

Habitat: Sudan.

Measurements.—Total length 4.3 cm.; length of the oral part 3.5 cm.; length of the pharyngeal part .8 cm.; greatest width 1.8 cm. These figures refer to the largest of five examples.

The *apex* has no mesial notch, no dorsal sulcus is present, and the structures mentioned on page 278 are absent. The whole dorsum is very rough.

The Circumvallate Papillæ.

Three small plane or umbilicated papillæ are arranged in the form of an isosceles triangle with an acute vertical angle. They are surrounded by prominent conical papillæ which may conceal the fossæ and vallums, or be a little distance from them. The two-pair type of vallate papillæ is rare (1 in 5).

The Fungiform Papillæ.

These stretch right across the dorsum and have the usual arrangement, but many are concealed by the long conical papillæ (text-fig. 22 C). All are hemispherical, smooth and polished, and some have a small central pit.

The Conical Papillæ.

The arrangement cannot be made out easily as their long and numerous points conceal the papillary bodies and interpapillary dorsum. Their distribution according to size is typical, however. All are filiform and have one or more points.

Lymphoid Nodules.

There are many large nodules, and several large duct orifices are visible in some specimens.

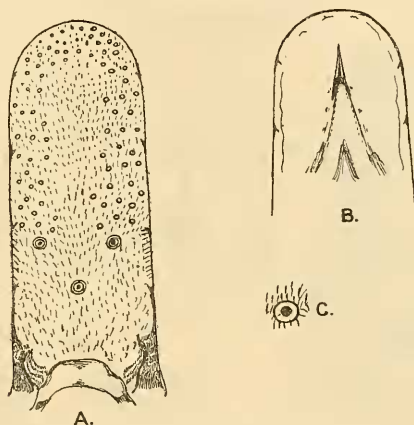
The Lateral Organs.

The sulci are wide, but not to such an extent as in *C. patas*, so the lateral organs appear to be composed of a row of small bodies each of which is furrowed. These are not, however, so prominent as in *C. patas*.

The measurements, etc., are given as follows:—

Organ.	Length.	Ridges.	Sulci.
Right	1.5 cm.	9	10
Left.....	1.2 „	8	9

Text-figure 22.

The tongue of *Cercopithecus æthiops*.*The Frenal Lamella* (text-fig. 22 B).

The triangular frenal lamella has an entire apex, and smooth plain edges which are free throughout their entire length.

The Median Ventral Sulcus.

The sulcus is short and opens into a wide triangular space. It lodges a small median crest.

THE GREEN CERCOPITHEQUE (*C. sabaeus*).

Habitat: Sierra Leone.

Several authors have described the patterns exhibited by the vallate papillæ. Mayer (7) described four pairs of papillæ, and Münch (8) recorded the two-pair form; he also mentions cases in which there were three papillæ with an additional small papilla on each limb of the V. In six cases I observed the two-pair type.

Measurements of my largest specimen:—Total length 4.9 cm.; length of the oral part 3.9 cm.; length of the pharyngeal part

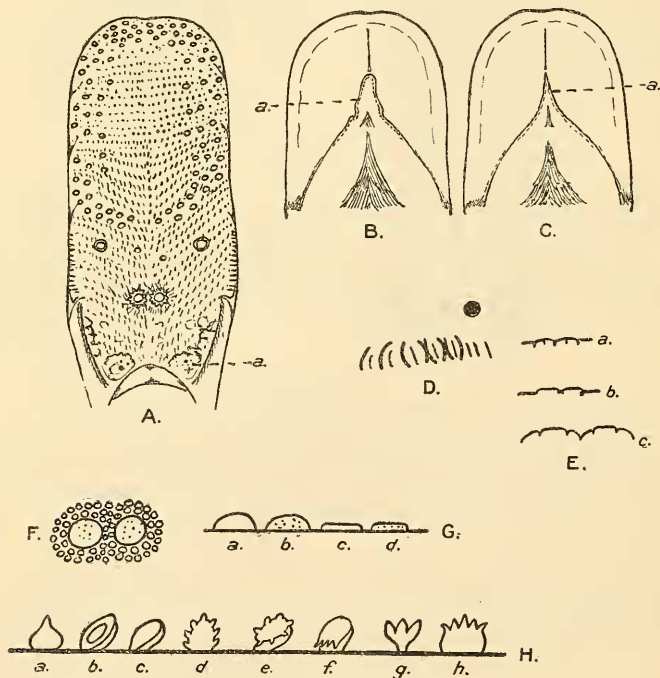
1 cm.; width between the lingual attachments of the palato-glossal folds 2 cm.

The *apex* has a mesial notch, and it and the *lateral borders* are covered with fungiform papillæ which are more numerous and prominent than in the species already described. The structures mentioned on page 278 are absent.

The Circumvallate Papillæ (text-fig. 23 E & F).

Four vallate papillæ are arranged in two pairs—anterior and posterior. The former correspond to the lateral papillæ of the triangular type, and the latter occupy the position of the posterior papilla. The posterior papillæ are close together (text-fig. 23 E).

Text-figure 23.



The tongue of *Cercopithecus sabæus*.

The anterior papillæ are surrounded by clear, smooth vallums. The posterior vallums are similar to the anterior ones, or are very prominent and crowded with conical papillæ (text-fig. 23 F).

The vallate area contains many conical and a few fungiform papillæ. The former vary greatly in size, and they were very large in a young specimen which I examined.

The papillæ vary greatly in their degree of projection (text-fig. 23 E).

The Fungiform Papillæ (text-fig. 23 G).

Fungiform papillæ are absent from the centre of the dorsum, and do not form a cluster in front of the vallate papillæ. In this respect the tongue resembles those of *C. preussi*, *C. burnetti*, and *C. mona*, and differs from that of *C. æthiops*. They form, therefore, a papillary zone on which they have the usual arrangement. Some are smooth and glistening, others are granular, and all are hemispherical or cylindrical in shape.

The Conical Papillæ (text-fig. 23 H).

Conical papillæ make the entire dorsum rough, but not to such a degree as in *C. patas* and *C. æthiops*. They have the usual arrangement in clusters and rows, and the direction in which their points run is typical. Between the rows there are strips of interpapillary dorsum.

None of them overlap the fungiform or vallate papillæ.

When they are examined through a lens it is seen how the papillæ vary greatly in shape and appear flattened out. The surface may be plane or excavated (text-fig. 23 H), and one or more processes are present.

The Lateral Organs (text-fig. 23 D).

The lateral organs consist of a series of short laminae and sulci convex forwards. Each ridge is bisected by a longitudinal sulcus. The measurements, laminae, and sulci are shown as follows:—

<i>Organ.</i>	<i>Length.</i>	<i>Laminae.</i>	<i>Sulci.</i>
Right	1·6 cm.	8	9
Left	1·5 „	5	6

The ridges decrease in size from before backwards, and the lateral vallate papillæ are level with the posterior laminae.

Lymphoid Nodules and Glands (text-fig. 23 A, a).

Prominent lymphoid nodules are present on the base of the tongue, and a number of orifices are visible.

The Frenal Lamella (text-figs. 23 B a & C a).

The frenal lamella is triangular and entire or bifid, being divided in the latter (text-fig. 23 B, a) into large left and small right parts. The edges are devoid of processes and tubercles and extend almost to the posterior fissures and laminae of the lateral organs.

The Frenum.

The frenum occupies the whole of the median ventral sulcus as a ridge, and the part stretching from the sulcus to the upper surface of the frenal lamella is very short, as in all Cercopithecidae.

Plicæ fimbriatæ are absent, even in the young specimen. The animal was older, however, than my young *C. patas* in which plicæ are present.

THE TANTALUS CERCOPIITHEQUE (*C. tantalus*).

Habitat: Nigeria.

Measurements.—Total length 4.6 cm.; length of the oral part 4 cm.; length of the pharyngeal part .6 cm.; width between the lingual attachments of the palato-glossal folds 2 cm.

The *apex* and *lateral borders* are the same as in *C. sabæus*, and there is no median dorsal sulcus.

The Circumvallate Papillæ.

Four vallate papillæ are arranged in the two-pair type, but the elements of the posterior pair are more widely separated than in *C. sabæus*. The left papillæ are oval and all the others are circular on plan. In some specimens both posterior papillæ are circular (text-fig. 24 K).

The vallums of the anterior pair are clear zones, or have the appearance of nodulated and granular bands (text-fig. 24 C), and those of the posterior papillæ are raised, as in *C. sabæus* (text-fig. 24 D), but are not so thickly crowded with conical papillæ. All the papillæ project beyond the vallums, and they are conical on elevation, with the broad ends free (text-fig. 24 L).

The Fungiform Papillæ (text-fig. 24 E).

The fungiform papillæ are placed on a zone round the anterior two-thirds of the dorsum, and they are arranged thereon in the typical manner. On the lateral borders they form a row of prominent bodies. They have, therefore, the same appearances as in *C. sabæus*.

They are hemispherical, cylindrical or lobulated, and their surfaces are smooth or granular.

The Conical Papillæ (text-fig. 24 F & G).

The conical papillæ have the usual arrangement, the common distribution according to size, and the typical mode of direction of the points. Through the lens they appear very similar to those of *C. sabæus*, but the additional forms are shown in text-fig. 24 F & G. Between the different rows the strips of inter-papillary dorsum are visible.

Lymphoid Follicles.

Several lymphoid follicles and duct orifices can be seen on the base of the tongue.

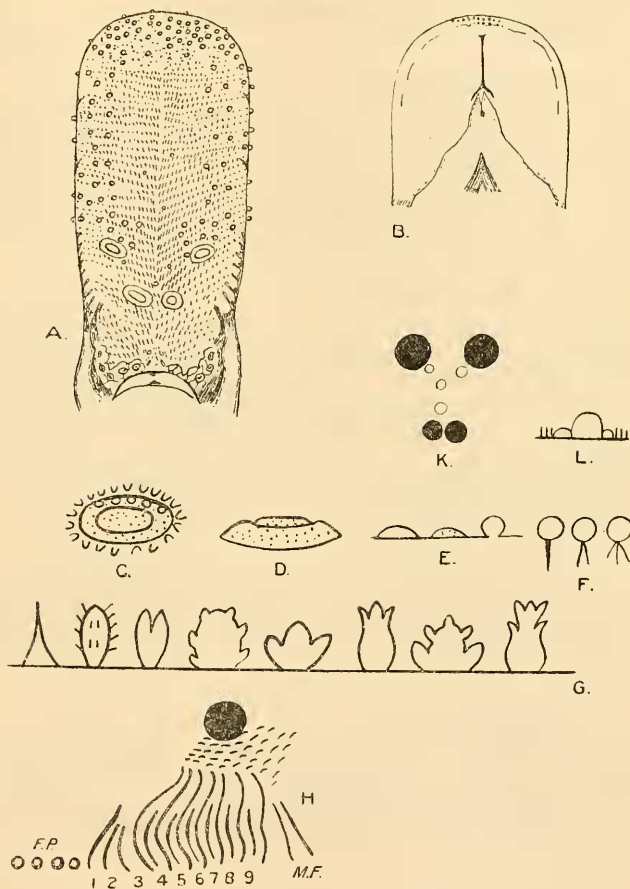
The Lateral Organs (text-fig. 24 H).

The lateral organs resemble those of *C. preussi*. They consist of a series of laminae and sulci running from behind forwards and inwards, and each of the former is traversed by a secondary sulcus. The whole organ diminishes in size from before backwards. Behind them are folds of the mucosa. The laminae do

not touch the lateral vallate papillæ as in *C. preussi*, but are separated from them by a papillary zone.

The measurements, ridges and laminae are shown as follows:—
The right organ is 1 cm. long, and has 5 laminae and 9 sulci.
The left organ is 1.2 cm. long, and has 8 laminae and 6 sulci.
In a second specimen there are 9 laminae and 10 sulci in each organ.

Text-figure 24.



The tongue of *Cercopithecus tantalus*.

The Frenal Lamella.

The triangular frenal lamella has a bifid apex and crenated edges running backwards as far as the lateral organs.

No *plicæ fimbriatæ* are present.

THE MOZAMBIQUE CERCOPITHEQUE (*C. rufoviridis*).

Habitat: Mozambique.

The tongue, which is widest between the anterior limits of the lateral organs, has the following *measurements*:—Total length 4·6 cm.; length of the oral part 3·8 cm.; length of the pharyngeal part ·8 cm.; greatest width 1·8 cm. These figures refer to the larger of two specimens.

The *apex* and *lateral borders* are similar to those of *C. sabaeus* and *C. tantalus*.

The Circumvallate Papillæ.

There are two pairs of vallate papillæ—anterior and posterior—and the posterior elements are close together. All are circular, prominent and granular, the fossæ are well-marked, but the vallums are not easily distinguishable from the surrounding dorsum. In my second specimen small papillæ lie between the four large ones of the double pair.

The Fungiform Papillæ.

Fungiform papillæ are absent from the centre of the dorsum, so they form a papillary bounding zone. The apical cluster is large, and the oblique posterior rows are close together. The former set contains large papillæ. On the inferior surface the apical papillæ form a prominent cluster, but there is a single row of papillæ posteriorly.

All are hemispherical, smooth and polished, and none are overlapped by conical papillæ.

The Conical Papillæ.

The papillæ have the typical arrangement in rows and clusters. Most of them have cylindrical bodies surrounded by a zone of interpapillary dorsum, and they give the tongue a sago-grain appearance.

The Lateral Organs.

Deep sulci separate short, flat laminae. The right organ is 1 cm. long, and has 7 laminae and 8 sulci. The left organ is 1·2 cm. long, and has 5 laminae and 6 sulci.

A few *orifices of gland ducts and pits* are present on the base of the tongue.

The Frenal Lamella.

The triangular lamella has a bifid apex, and its smooth edges extend back to the anterior limits of the lateral organs.

The *median ventral sulcus* is shallow and triangular.

The Vervet Cercopitheque (*C. pygerythrus* or *lalandii*) has a long, narrow, bifid lamella (text-fig. 20 F).

THE DIANA GROUP.

Tuckerman (11) has described the tongue of *C. diana* and pointed out that it has a vallate triangle. He states that it has no frenal lamella, but does not explain whether the tongue was carefully removed. The lamella is easily cut away unless great care is taken in removing the tongue.

THE PETAURISTA GROUP.

Münch (8) has pointed out that the tongue of *C. petaurista* has a triangular vallate area.

Mr. Pocock's sketch of the tongue of Schmidt's *Cercopithecus* (*C. schmidtii*) has a conical, or oval, undivided frenal lamella (text-fig. 20 E).

Summary of the Tongues of the Species of Cercopithecus.

1. The tongues are conical or spatulate.
2. Apical notches and median dorsal sulci are variable.
3. The foramen cæcum, lytta, and Apical Gland of Blandin are absent.
4. Plicæ fimbriatæ are absent in the adult, but may be present in the young animal, as Deniker described in the Gorilla and Gibbons.
5. The lateral organs appear as flat laminae and sulci, or as rows of oval bodies.
6. The vallate papillæ form a V, T, triangle or double-pair arrangement, and it must be stated that the type described in each species is the commonest in a large series of examples which were examined by me or recorded by others.
7. The frenal lamella has an entire or bifid apex.
8. Fungiform papillæ form a dorsal bounding zone or stretch across the whole dorsum.
9. It is not possible to group the *Cercopithecus* by the nature of the tongues as one can by their external characters, and I have arranged them in their zoological series to show this. Most of the species in the *Æthiops* Group have a double-pair of vallate papillæ, but others have the triangular type, and that is as far as one can go.
10. Some examples of *C. patas* and *C. tantalus* are pigmented.

Genus MACACUS.

THE RHESUS MACAQUE (*M. rhesus*).

Habitat: India.

Tuckerman (11) has briefly described the tongue, and most of his account deals with the gustatory papillæ. He has described

a vallate triangle, but I only observed that form once in fifty-eight cases. I give the following *measurements* as those of my largest specimen:—Total length 5.4 cm.; length of the oral part 4.7 cm.; length of the pharyngeal part .7 cm.; width between the anterior limits of the lateral organs 2.3 cm.

The rounded *apex* and the *lateral borders* are the same as in *C. preussi*, and the structures mentioned on page 278 are also absent.

The Circumvallate Papillæ.

In fifty-eight examples I observed three papillary patterns which are described as follows:—

Specimen No. 1 (type present in fifty-six examples):—There are two pairs of vallate papillæ, and the members of the posterior pair lie close together, but their relative positions differ (text-fig. 25 C, D, G). The fossæ are well-marked, and those of the anterior pair have recesses at their anterior and posterior poles (text-fig. 25 J). The fossæ of the posterior pair have no such recesses. All the vallums are prominent and granular.

Von Ebner has published an illustration of the histology of the posterior papillæ (14).

Within the vallate area there are both conical and fungiform papillæ.

Specimen No. 2 (type observed only in one case):—Three vallate papillæ form an isosceles triangle, the posterior papilla of which is oval. The sides are filled in by ridges of the mucosa. Within the vallate triangle there is a triangle of fungiform papillæ (text-fig. 25 E).

Specimen No. 3 (occurring once):—Five papillæ form a V with the apex behind. The three terminating papillæ are large and prominent, and the middle papillæ of the limbs are small, but prominent. All the fossæ and vallums are well-marked, and the vallate area contains V-shaped rows of fungiform papillæ (text-fig. 25 F).

The Fungiform Papillæ (text-fig. 31 A).

The entire oral part of the dorsum is covered by fungiform papillæ, but these have the usual arrangement in clusters and rows. Occasionally, however, they may be absent from the centre of the dorsum. They are small, but prominent, on the lateral borders, and form a well-marked cluster behind the apex on the inferior surface.

Tuckerman (11) has shown that the apical papillæ have well-developed taste-buds.

The Conical Papillæ (text-fig. 31 B).

The conical papillæ have the usual arrangement, but the close aggregation and mutual compression of the elements somewhat obscure the pattern. They have one or more points which are

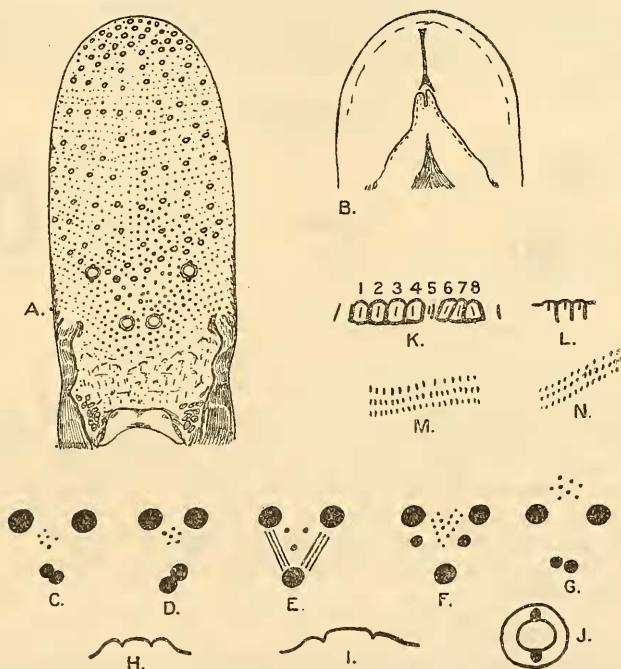
directed in the usual manner. The inter-papillary dorsum forms strips (text-fig. 25 M & N).

On the base of the tongue the *glands and lymphoid nodules* form elevations of different sizes, and a few minute orifices of ducts and pits are present.

The Lateral Organs (text-fig. 25 K & L).

The laminae and sulci are short and either straight or convex forwards. The laminae are mostly traversed by secondary sulci, and the main sulci vary in width. The left organ is 1.1 cm. long,

Text-figure 25.



The tongue of *Macacus rhesus*.

and has 8 laminae and 9 sulci. The right organ is 1.2 cm. long, and has 11 laminae and 12 sulci. At each end of each organ there are small folds of mucosa.

The Frenal Lamella.

The triangular lamella has a bifid apex, and the upper surface of the free part is devoid of sulci. The edges, which extend postero-laterally as far as the anterior limits of the lateral organs, are plain anteriorly and tuberculated posteriorly.

THE COMMON MACAQUE (*M. fascicularis*).

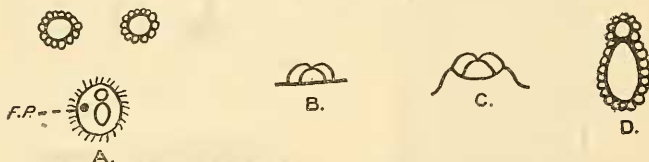
Habitat: Malay States.

Tuckerman (11) has briefly described the tongue, and the following details supplement his account. *Measurements*:—Total length 4·6 cm.; length of the oral part 3·9 cm.; length of the pharyngeal part ·7 cm.; width between the anterior extremities of the lateral organs 1·9 cm. These measurements refer to the largest of twelve examples.

The *apex* and *lateral borders* are the same as in *M. rhesus*, and the usual structures are absent.

The variations in the vallate papillæ are not so numerous as in *M. rhesus*, but the fungiform and conical papillæ are very similar. The former are absent from the centre of the oral part of the dorsum in most cases, whereas that is the occasional form in *M. rhesus*.

Text-figure 26.

The circumvallate papillæ of *Macacus fascicularis*.*The Circumvallate Papillæ* (text-fig. 26).

Two types can appear:—1. There are two pairs of papillæ whose appearances, and their variations, resemble those of *M. rhesus*. 2. There is an anterior pair of papillæ, and a posterior cluster of three which stand either on a plane surface or on the summit of an elevation. The vallums consist of one or more rows of nodules, and may contain fungiform papillæ.

A few minute *orifices of ducts and pits* are present on the base of the tongue.

The Lateral Organs.

The short laminae and sulci are arranged in a straight line or in a curve convex downwards. Many of the laminae have small secondary sulci. The right organ is ·9 cm. long, and has 6 laminae and 7 sulci. The left organ is ·9 cm. long, and has 5 laminae and 6 sulci.

The *frenal lamella* is triangular and has a bifid apex.

THE BONNET MACAQUE (*M. sinicus*).

Habitat: Continental India.

Tongues of Bonnet Macaques differ in size and shape. They may taper from the palato-glossal folds towards both apex and base, or their widest point may be between the anterior

extremities of the lateral organs. My largest specimen belongs to the latter class and has the following *measurements*:—Total length 6·6 cm.; length of the oral part 5·4 cm.; length of the pharyngeal part 1·2 cm.; greatest width 2·4 cm.

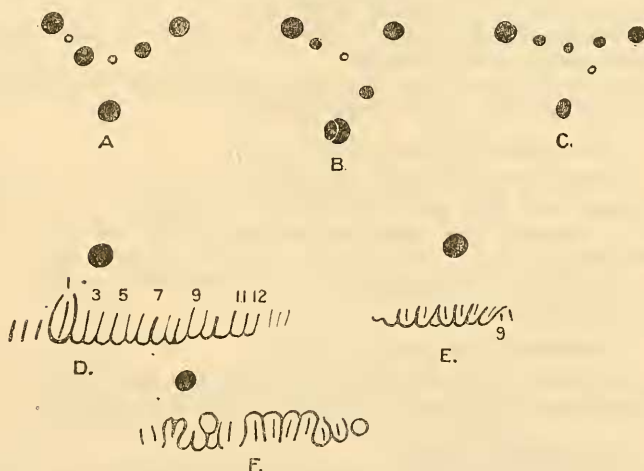
The *apex* is rounded, has no mesial notch, and bears conical and fungiform papillæ, but the latter are neither numerous nor prominent. The fungiform papillæ on the *lateral borders* and *inferior surface* are also insignificant and few in number.

The following structures are absent:—mesial dorsal sulcus, dorsal ridges, foramen cæcum, lytta, and Apical Gland of Blandin or Nuhn.

The Circumvallate Papillæ.

The vallate papillæ are arranged in the form of the letter Y or V, and I subjoin detailed descriptions of the vallate areas of three specimens.

Text-figure 27.



The vallate papillæ and lateral organs of *Macacus sinicus*.

Specimen No. 1:—The vallate papillæ form a V, with the angle posterior. Each limb has two papillæ, so, including the posterior papilla, there are five altogether. Each papilla is circular and prominent, its fossa is well-marked, and its vallum appears as a clear zone. On examination through a lens the papillæ and vallums appear granular. The middle papilla of the right limb is displaced mesially, and there is a fungiform papilla between the two mesial papillæ, so a false appearance of a Y is produced (text-fig. 27 A).

Specimen No. 2:—The papillæ also form a V, but the limbs differ greatly. Those of the left limb are close together, but the mesial papilla of the right limb lies close to the posterior

papilla (text-fig. 27 B). All but the posterior papilla are circular; the fossæ are plain and the vallums appear as clear zones. The posterior papilla is compound, and consists of two elements included within the same fossa. The right element is reniform, and the left one is oval. These two elements may represent a process of fusion of two elements of a posterior pair. If that be the case we may consider a single vallate papilla as the ultimate stage.

Specimen No. 3:—Six papillæ form the letter T. The horizontal limb consists of five elements, and the vertical limb consists of the middle horizontal papilla and one posterior papilla (text-fig. 27 C). All are circular, prominent, and granular.

The Fungiform Papillæ (text-fig. 31 A).

Although fungiform papillæ are scanty in the centre of the dorsum, they cover the entire oral part. They do not form, therefore, a wide dorsal papillary zone, and they have the usual arrangement in clusters and rows.

They are hemispherical or globular, and their edges may be overlapped by conical papillæ.

On the inferior surface they are clustered round the apex, but farther back they form a single chain.

The Conical Papillæ (text-fig. 31 B).

The conical papillæ have the usual arrangement in rows and clusters, and the usual distribution according to size. Those lying between the posterior vallate papillæ are large and well-marked.

They belong to the cylindrical and filiform series and have one or more points.

Lymphoid Tissue and Glands.

The glands and nodules on the base are well-marked, and several small orifices are present in front of the epiglottis.

The Lateral Organs.

The descriptions given below of the lateral organs of three examples correspond respectively to the three specimens whose vallate papillæ have already been described.

Specimen No. 1 (text-fig. 27 D):—A series of short laminae commence on the sides of the tongue, taper on the dorsum and run towards the lateral vallate papillæ, and are separated in the latter situation by wide shallow sulci. Many of the laminae, which are convex forwards, are traversed by secondary sulci. Some of the outer borders are rounded, but others merge into the under surface of the tongue. The right organ is .9 cm. long, and has 13 laminae and 14 sulci. The left organ is 1 cm. long, and has 12 laminae and 13 sulci. At either end there are small folds of mucosa.

Specimen No. 2 (text-fig. 27 E):—The short, rounded, furrowed laminae are separated by wide primary sulci. The right organ is

1.4 cm. long, and has 10 laminæ and 11 sulci. The left organ is 1.3 cm. long, and has 9 laminæ and 10 sulci.

Specimen No. 3 (text-fig. 27 F):—The laminæ and sulci are short and convex forwards, and the latter look like series of short incisions into the lateral borders of the tongue. The right organ is .8 cm. long, and has 12 laminæ and 13 sulci. The left organ is .7 cm. long, and has 11 laminæ and 12 sulci.

The Frenal Lamella.

The frenal lamella is triangular. The apex expands and is either rounded and entire, or pointed and bifid. The edges extend postero-laterally almost to the posterior ends of the lateral organs.

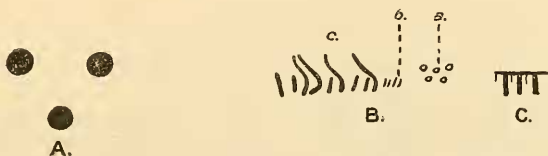
THE TOQUE MACAQUE (*M. pileatus*).

Habitat. Ceylon.

The spatulate tongue has the following *measurements*:—Total length 4.7 cm.; length of the oral part 3.9 cm.; length of the pharyngeal part .8 cm.; width between the lingual attachments of the palato-glossal folds 1.7 cm.

The *apex* and *lateral borders* are the same as in *M. rhesus*, and the same structures are absent.

Text-figure 28.



The vallate papillæ and lateral organs of *Macacus pileatus*.

The Circumvallate Papillæ (text-fig. 28 A).

The isosceles vallate triangle has an obtuse vertical angle; the two anterior papillæ are small, but the posterior one is large and oval. The fossæ are well-marked, and the vallums are clear, prominent zones. Within the vallate triangle there are both conical and fungiform papillæ.

The *conical* and *fungiform papillæ* have the usual arrangement, but the latter are large anteriorly and small posteriorly. Large clusters of fungiform papillæ are present behind the apex and in front of the lateral organs on the inferior surface.

Few *orifices of gland ducts* are present on the base of the tongue.

The *frenal lamella* has a bifid apex and plain sides.

The Lateral Organs (text-fig. 28 B & C).

The laminæ and sulci are all short, and are either straight or

bent with the angles directed forwards. The right organ is 1 cm. long, and has 8 laminae and 9 sulci. The left organ is 1.1 cm. long, and has 9 laminae and 10 sulci. At the anterior extremities are fungiform papillae (*a*) and false folds (*b*), the true laminae and sulci being shown at *c*. The organs are flat on elevation (*C*).

THE PIG-TAILED MACAQUE (*M. nemestrinus*).

Habitat: East Indies and Malay States.

Measurements.—Total length 8.4 cm.; length of the oral part 7.3 cm.; length of the pharyngeal part 1.1 cm.; width between the lingual attachments of the palato-glossal folds 2.7 cm.

The *apex* and *lateral borders* are the same as in *M. rhesus*, and the same structures are absent.

Text-figure 29.



The vallate papillae (A) and lateral organs (B) of *Macacus nemestrinus*.

The Circumvallate Papillae (text-fig. 29 A).

Seven papillae are arranged in the V-type. All are very prominent, the fossae are clearly defined, and the vallums form well-marked zones. In this formation my specimen resembles that of Münch (8), but differs from Mayer's example (7) in which there were four vallate papillae. The vallate area contains both conical and fungiform papillae. In my second specimen the apical papilla is replaced by three papillae deeply sunk within the common fossa. It is unusual to have the three papillae of a cluster deeply recessed; they are usually prominent.

The Fungiform Papillae (text-fig. 31 A).

The distribution is the same as in *M. rhesus*, but they are not so numerous in the centre of the oral part of the dorsum. They are very numerous behind the apex and in front of the vallate area. The ventral apical cluster is also large, but the posterior part of the ventral papillary zone has few papillae.

The Conical Papillae (text-fig. 31 B).

The arrangement of the papillae and inclination of their points take the usual form.

The papillary bodies are flat, conical or cylindrical, and the number of points is variable.

A few minute *orifices of gland ducts and pits* are present.

The Lateral Organs (text-fig. 29 B).

The short, wide sulci, which run forwards and upwards, separate flat, furrowed laminae. The right organ is 1.4 cm. long, and has 11 laminae and 12 sulci. The left organ is 1.2 cm. long, and has 10 laminae and 11 sulci.

The apex of the triangular *frenal lamella* is slightly cleft and rounded.

I have not observed the row of glandular bodies under the tongue described by John Hunter (16).

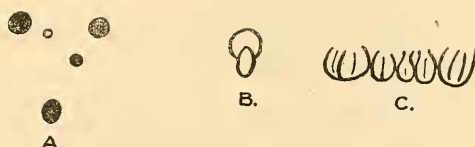
THE STUMP-TAILED MACAQUE (*M. speciosus*).

Habitat: Burmah.

Measurements.—Total length 5.8 cm.; length of the oral part 4.7 cm.; length of the pharyngeal part 1.1 cm.; greatest width 2.6 cm.

The *apex* has a mesial notch. The *lateral borders* have the usual characters, and the structures mentioned on page 278 are absent.

Text-figure 30.



The vallate papillae and lateral organs of *Macacus speciosus*.

The Circumvallate Papillae (text-fig. 30 A & B).

Four vallate papillae are arranged in the V-type. Including the posterior papilla, the right limb has three elements, but the left one has only two. The left anterior papilla is round and umbilicated, the fossa is clearly marked, and the vallum is flat and granular. The right anterior papilla is oval, granular, and recessed, the fossa is clearly marked, and the vallum appears as a prominent circular band. The posterior papilla is large and prominent; it has a central club-shaped papilla, and is surrounded by a lobulated vallum.

The Fungiform Papillae (text-fig. 31 A).

The fungiform papillae are neither numerous nor prominent, but they stretch right across the dorsum. They have the usual arrangement in clusters and rows. On the lateral borders and inferior surface they are discrete. They are hemispherical or pedunculated, and none are overlapped by conical papillae.

The Conical Papillae (text-fig. 31 B).

Their arrangement and disposition according to size and direction of their points follow the usual plan, and the inter-papillary dorsum appears in the form of strips. There is no great variation in their types.

The Lateral Organs (text-fig. 30 C).

The lateral organs appear as rows of short, furrowed, flat laminae separated by wide sulci. The rows may form a straight line, or be convex downwards. The right organ is 1.7 cm. long, and has 13 laminae and 14 sulci. The left organ is 1.5 cm. long, and has 6 laminae and 7 sulci.

Lymphoid Tissue and Glands.

On the sides of the base there are many small round eminences with central openings, and a few are situated in front of the epiglottis. They are more numerous than in any other *Macacus* tongue which I examined, but they do not occupy such a large proportion of the tongue as in the *Langurs*.

The Frenal Lamella.

The triangular lamella has a bifid apex, the halves of which taper from a wide base. The edges extend postero-laterally as far as the middle of the lateral organs. The upper surface of the free part is smooth.

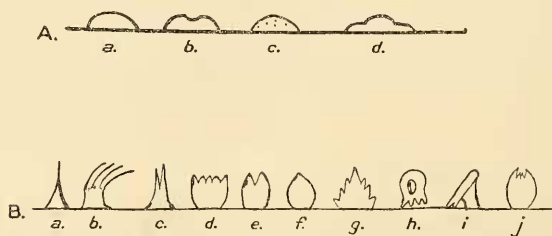
The *ventral papillary border* is narrow and has few papillae, but these have the usual disposition.

The *median ventral sulcus* lodges a triangular crest which is larger than in all other *Primates*.

THE BARBARY APE (*M. inuus*).

Chatin (4) and Münch (8) have described the tongue of *M. inuus* or *ecaudatus*, and recorded that it has a vallate triangle. The latter examined thirteen tongues of Macaque monkeys and only found the vallate triangle in this species.

Text-figure 31.



The fungiform (A) and conical (B) papillae of the Macaques.

THE PHILIPPINE MACAQUE (*M. philippinensis*).

Mr. R. I. Pocock has lent me the sketch of the frenal lamella which is simply bifid.

The fungiform papillae (text-fig. 31 A) and conical papillae

(text-fig. 31 B) present a uniformity of types, as shown in these figures, in all species.

Summary of the Genus Macacus.

1. The vallate papillæ are arranged in the triangular, V-type, or double-pair formation, and all forms may appear in any species if sufficient examples of each are studied, as shown in the introduction to this paper, and in the description of *Macacus rhesus*.
2. The pharyngeal part of the tongue is relatively larger in the genus *Macacus* than in the genus *Cercopithecus*.
3. The glandular orifices are, in most cases, like pin-holes. They are largest in *Macacus speciosus*.
4. The vallate papillæ may have recesses at their anterior and posterior poles, and in no other genus of the Cercopithecidae did I see these.
5. The frenal lamella is more frequently bifid than entire.

Genus CEROCEBUS.

WHITE-COLLARED MANGABEY (*C. ethiopicus*).

Habitat: West Africa.

Measurements.—Total length 4·8 cm.; length of the oral part 3·6 cm.; length of the pharyngeal part 1·2 cm.; width between the lingual attachments of the palato-glossal folds 2 cm.; thickness in the vallate area ·95 cm.

The *apex* is rounded, has a delicate median notch, and is roughened by closely-set conical and fungiform papillæ, and the fungiform papillæ on the *lateral borders* are prominent and close together. These lateral papillæ are followed by a row of larger oval bodies which compose the lateral organs.

A fine *mesial sulcus* runs along the dorsum.

The Circumvallate Papillæ.

Three large white circular vallate papillæ are arranged in the form of an acute-angled isosceles triangle, with the apex posterior. They offer a marked contrast to the yellow dorsum.

All the papillæ are smooth, polished and glistening, the fossæ are well marked, and the vallums appear as clear flat zones.

The Fungiform Papillæ.

The fungiform papillæ are absent from the centre of the oral part of the dorsum; on the sides they are arranged in clusters and rows in the usual manner.

All are hemispherical, smooth and polished, and there is no overlapping by conical papillæ.

The fungiform area is bounded posteriorly by a V-shaped row of papillæ running backwards and inwards from the anterior extremities of the lateral organs to the middle of the vallate area.

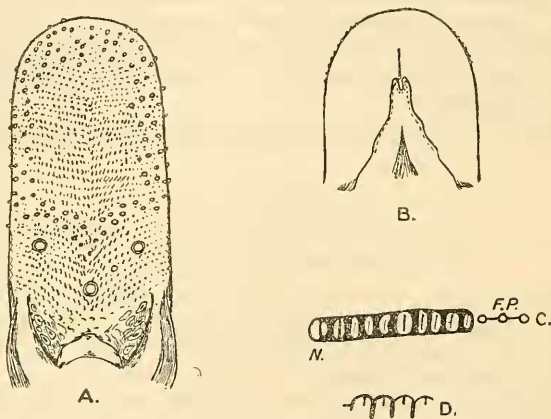
The Conical Papillæ.

The conical papillæ are arranged in the typical form, and the direction of the points takes the usual course. Those on the base are large.

The papillæ have cylindrical, conical or compressed bodies, and have one or more points.

At the insertions of the palato-glossal folds there are clusters of pedunculated papillæ, but histological examination alone reveals whether these are conical or fungiform in type.

Text-figure 32.

The tongue of *Cercocebus aethiopicus*.*Lymphoid Follicles and Ducts.*

On the base of the tongue there is on each side a large cluster of lymphoid nodules, and several large ones have orifices of ducts or pits. The two masses are separated by the median glosso-epiglottic fold.

The Lateral Organs (text-fig. 32 C & D).

On each side of the tongue there is a row of laminae and sulci. The latter are short and wide, and the former are small and rounded, so the organs look like rows of beads. The laminae are smooth, furrowed, or crossed by a ridge, and are single or double (text-fig. 32 C, N).

The measurements, laminae, and sulci are shown as follows:—

Organ.	Length.	Laminae.	Sulci.
Right	1 cm.	9	10
Left	1.1 ,,	8	9

The Frenal Lamella.

The apex is bifid, and the edges, which are tuberculated posteriorly, extend as far as the middle of the lateral organs.

The *ventral papillary zone* is widest in front. It has a single row of fungiform papillæ.

The structures mentioned on page 278 are absent.

Münch (8) has shown that the tongue of the Sooty Mangabey (*C. fuliginosus*) has a vallate triangle.

THE WHITE-CROWNED MANGABEY (*C. lunulatus*).

Habitat: West Africa.

Measurements.—Total length 5 cm.; length of the oral part 4.4 cm.; length of the pharyngeal part .6 cm.; width between the lingual attachments of the palato-glossal folds 2.3 cm.

The *apex* is flat and devoid of a notch. It is very closely studded with small fungiform papillæ. The *lateral borders* are more rounded than in *C. æthiopicus*, but their fungiform papillæ are more numerous, smaller, and arranged in more than one row.

The usual structures are absent (see page 278).

Text-figure 33.



The vallate papillæ (A) and lateral organs (B) of *Cercocobus lunulatus*.

The Circumvallate Papillæ (text-fig. 33 A).

Three papillæ form an isosceles triangle with an acute apex, but they are not so large nor prominent as in *C. æthiopicus*. Moreover, they are not thrown into prominence by the contrast between their white colour and pigment of the dorsum, for the tongue is devoid of colour. All are circular and vary in protrusion or retraction, the fossæ are clearly-cut, but the vallums are not prominent.

The Fungiform Papillæ.

The character and distribution are the same as in *C. æthiopicus*, but the papillæ are smaller and more numerous.

All the papillæ are hemispherical, and their surfaces are smooth or granular.

The Conical Papillæ.

Their arrangement and distribution according to size follow the usual plan.

The papillary bodies are cylindrical, irregular or tapering, and

they have one or more points. The interpapillary dorsum appears as streaks.

Glands and Lymphoid Tissue.

The base of the tongue is nodulated, and a few orifices of glanducts and pits are present, as in *C. ethiopicus*.

The Lateral Organs (text-fig. 33 B).

The lateral organs present a very different appearance to those of *C. ethiopicus*, for they do not look like rows of small oval bodies. They consist of a series of flat, furrowed, laminae separated by wide primary sulci, and those in the centre of the organs are larger than those at the sides. The right organ is 1.1 cm. long, and has 10 laminae and 11 sulci. The left organ is 1.1 cm. long, and has 8 laminae and 9 sulci. One of the right laminae has three furrows (text-fig. 33 B, a).

The Frenal Lamella.

The triangular frenal lamella has a bifid apex, and the plain edges extend back as far as the posterior ends of the lateral organs.

The *ventral papillary zone* maintains an even width, and the *median ventral sulcus* is narrow and deep.

Genus THEROPITHECUS.

Garrod (6) has pointed out that the Gelada Baboon (*T. gelada*) has a triangular vallate area.

Genus PAPIO (= CYNOCEPHALUS).

THE GUINEA BABOON (*P. sphinx*).

Habitat: Africa.

The conical tongue has the following *measurements*:—Total length 6 cm.; length of the oral part 4.6 cm.; length of the pharyngeal part 1.4 cm.; width between the lingual attachments of the palato-glossal folds 2.6 cm.

The rounded *apex* has no notch, and is very thickly clustered with very small fungiform papillae. The *lateral borders* are rounded and possess many fungiform papillae arranged in the usual manner. At their posterior ends the lateral organs are situated.

The Circumvallate Papillae.

Type—double pair.

The two anterior papillae are large, circular, smooth and prominent, the fossae are clearly defined, and the vallums are nodulated. Both posterior papillae, of which the left one is the

larger, are smooth, oval, and contained within well-marked fossæ; both stand on a nodulated elevation (text-fig. 34).

Brücher (3) has figured a tongue with six papillæ arranged in the form of a V.

The Fungiform Papillæ.

The fungiform papillæ form a dorsal bounding zone which is broad, and they have the usual arrangement thereon. They are very numerous and prominent, and, with the exception of a cluster of small ones in the mid-line behind, they increase in size in the usual manner. Those on the lateral borders and inferior surface are also numerous, prominent, and close together.

They are hemispherical or bossed, their surfaces are mostly smooth, and none are overlapped by conical papillæ (text-fig. 35).

The Conical Papillæ (text-fig. 35).

The conical papillæ have the usual distribution and the usual arrangement according to their size and the direction of their points. They have flat or tapering bodies and one or more points. Between them the interpapillary dorsum appears as strips.

At the sides of the base of the tongue there are a few small orifices of glandular ducts and pits.

The Lateral Organs (text-fig. 34).

The lateral organs are confined almost entirely to the lateral borders. They consist of a series of wide sulci separating laminæ which are short, traversed by secondary sulci, and more or less rounded. The organs, therefore, look like rows of small oval bodies. The left organ is 1.2 cm. long, and has 9 laminæ and 10 sulci. The right organ is 1.3 cm. long, and has 8 laminæ and 9 sulci.

The Frenal Lamella (text-fig. 36).

The triangular lamella has a deeply-cleft apex, and the upper surface of the free anterior part is smooth. The edges, which extend postero-laterally as far as the levels of the anterior limits of the lateral organs, bear tubercles and pointed processes anteriorly, and are undulating posteriorly.

The *ventral papillary zone* narrows from before backwards, and is crowded with conical and fungiform papillæ arranged in the usual manner.

The *median ventral sulcus* is narrow and deep throughout its entire length, and a ridge passes into it from the upper surface of the frenal lamella. No *median dorsal sulcus* is present, however, in the fresh tongue.

Mr. R. I. Pocock has lent me a sketch of the frenal lamella in which the apex is divided into two large diverging processes (text-fig. 36).

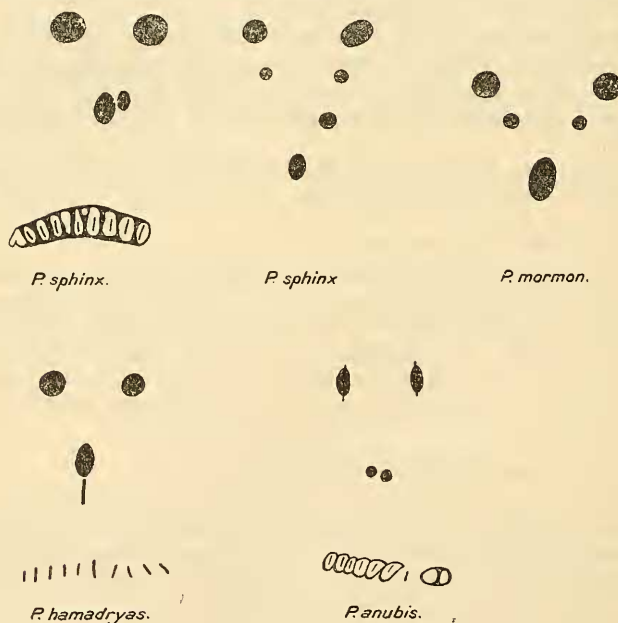
THE ARABIAN BABOON (*P. hamadryas*).

Habitat: Arabia and Abyssinia.

The spatulate tongue has the following *measurements*:—Total length 7·4 cm.; length of the oral part 5·7 cm.; length of the pharyngeal part 1·7 cm.; width between the lingual attachments of the palato-glossal folds 2·6 cm.; width of the anterior third 2·9 cm.

The flat *apex* has no mesial notch, and its papillæ are insignificant. The *lateral borders* are rounded, and their papillæ are also small; their fungiform papillæ are discrete (separate). Running back from the apex for 2·4 cm. there is a deep *mesial dorsal sulcus*.

Text-figure 34.



The tongues of the Baboons.

The upper figures are vallate papillary patterns, and the lower figures of *P. sphinx*, *P. hamadryas*, and *P. anubis* represent lateral organs.

The Circumvallate Papillæ (text-fig. 34).

Four papillæ form a V with a backwardly-directed apex. The left limb consists of three papillæ, including the posterior one, whereas the right limb has two. The posterior papilla is large, oval, smooth and glistening, the fossa is clearly cut and has

a posterior straight prolongation; its vallum is prominent, granular and coarsely nodulated. All the other papillæ are small and circular; their bodies are smooth and polished, their fossæ are sharply cut, and their vallums appear as clear zones. The two small papillæ on the left limb appear to stand on a common vallum.

Within the vallate area there are several large fungiform papillæ which can easily be mistaken for the small anterior vallate papillæ, but the pocket lens reveals how they have neither fossæ nor vallums. The area is also considerably roughened by conical papillæ.

The Fungiform Papillæ (text-fig. 35).

The fungiform papillæ are absent from a small area on the middle of the dorsum, but they have the usual arrangement elsewhere. They are all hemispherical or bossed, and are surrounded, but never concealed, by the conical papillæ.

The ventral apical cluster contains small elements.

The Conical Papillæ (text-fig. 35).

The conical papillæ have the usual arrangement, and the usual direction for their points. They have flat, cylindrical or tapering bodies, and the number of points which each possesses varies. Between the rows the interpapillary dorsum appears as strips. The papillæ on the base are prominent.

Glands and Lymphoid Nodules.

Several prominent elevations are formed on the base by lymphoid nodules, and several orifices are present. These are minute in front of the epiglottis, but there is, on each side of the base of the tongue, a row of prominent round or slit-like orifices stretching along the whole length of the palato-glossal folds. These are more pronounced than in *P. sphinx*.

The Lateral Organs (text-fig. 34).

On each lateral border there is a series of short furrowed laminæ separated by wide sulci. The laminæ do not project, however. Some of the more posterior laminæ appear as oval bodies incised by deep secondary sulci, but these must not be mistaken for glandular pits, from which they are separated by a short interval. The right organ is 1.9 cm. long, and has 11 laminæ and 12 sulci. The left organ is 1.8 cm. long, and has 12 laminæ and 13 sulci.

The Frenal Lamella (text-fig. 36).

The lamella has a rounded, entire, finely crenated apex, and the edges, which are not prominent, extend almost as far back as the middle of the lateral organs.

THE CHACMA BABOON (*P. porcarius*).

Habitat: South Africa.

The tongue is spatulate and has the following measurements:—Total length 10·3 cm.; length of the oral part 8·6 cm.; length of the pharyngeal part 1·7 cm.; width between the lingual attachments of the palato-glossal folds 3·2 cm.; width of the anterior third 4 cm.; thickness in the vallate area 2·4 cm.

The *apex* is flat and has a mesial notch whence a mesial dorsal sulcus runs back for 1 cm. It is covered by small conical and fungiform papillæ which are all visible to the naked eye; they are not, however, so prominent as in some species of *Cercopithecus*.

The *lateral borders* are similar to those of the *Cercopithecus* in general both as regards papillæ and lateral organs. The fungiform papillæ are discrete.

The Circumvallate Papillæ.

Three large prominent vallate papillæ form an equilateral triangle (each side = 1·5 cm.) with the apex behind. Within that there is a small vallate V consisting of three very small papillæ on the left limb and two on the right. Münch (8) has described small papillæ as being remnants of an anterior V-row, and Brücher (3) has figured them as connecting the large papillæ in *P. sphinx*, but my specimen is more in support of Münch's views than is Brücher's illustration.

All the large papillæ are circular and have granular surfaces; their fossæ are well-marked, and the vallums appear as white granular rings raised above the level of the rest of the dorsum. The small papillæ are circular and prominent, but their vallums are not raised.

Within the vallate area there are many conical and a few fungiform papillæ which can be mistaken for the small vallate V. To distinguish the latter I have coloured them black in text-fig. 35. In my second specimen five large papillæ form a V.

The Fungiform Papillæ.

Fungiform papillæ cover the whole of the oral part of the dorsum, but are few in number in the centre. They have the usual arrangement in clusters and rows, but the anterior cluster covers a larger area than in any species of *Cercopithecus*; it covers the whole of the anterior third of the tongue. On the lateral borders and inferior surface they form a single row of discrete elements.

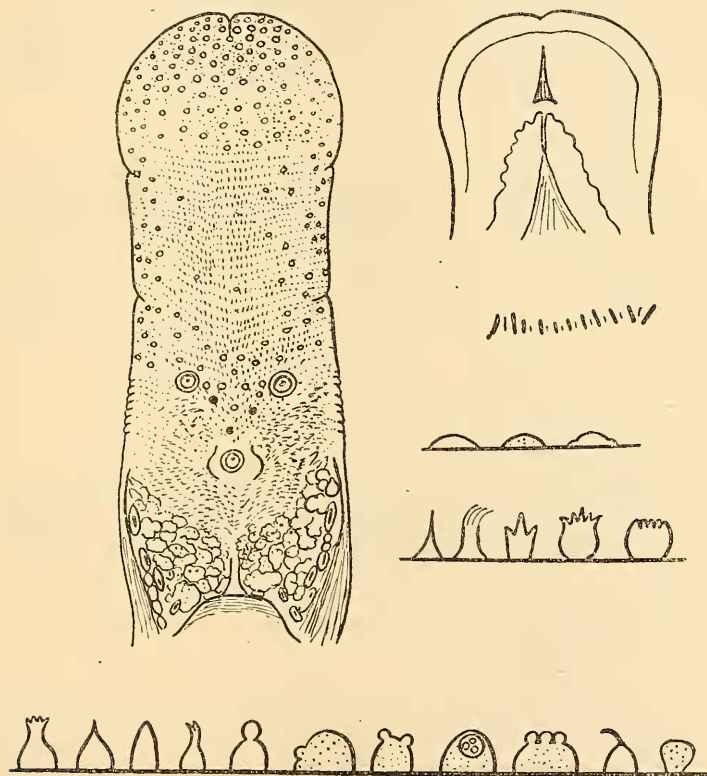
All the papillæ are hemispherical and a few have central bosses. Their surfaces are smooth or granular.

The Conical Papillæ.

The conical papillæ extend back on to the epiglottis. They have the usual arrangement in clusters and rows, but the

directions of the latter are not so clearly marked as in other Cercopithecidae. In their type and arrangement, and their enormous development on the base of the tongue, they resemble the conical papillæ of the Gorilla. They differ in the latter respect from the conical papillæ of *P. anubis*. The points of the papillæ are directed backwards, or backwards and inwards in the usual manner.

Text-figure 35.



The dorsum, inferior surface, and lateral organs of *Papio porcarius*, and the fungiform and conical papillæ of the Baboons.

When they are examined through the lens it is seen how they present a large variety of forms which are shown in text-fig. 35.

Behind the apex, on the dorsum, there are many cylindrical and a few filiform papillæ. In the middle third the papillary bodies are flat and scale-like, and their margins are plain or prolonged into a variable number of processes. On a zone lateral and posterior to the large vallate papillæ the conical papillæ are

of medium size; and their bodies are cylindrical, conical or fusiform, and are plain or have processes. Behind the zone and extending on to the epiglottis are large papillæ which are spherical, shield-like or tuberosæ; they may or may not have processes. On the sides and inferior surface the papillæ are small and filiform.

Lymphoid Nodules and Glands.

The base of the tongue has glands and lymphoid nodules of variable size, and large duct orifices are present in rows on the elongated lateral masses. It is difficult, without preparing sections, to determine whether a small nodule is a large papilla or a lymphoid nodule.

The Lateral Organs.

The lateral organs consist of small fissures and laminae on the lateral borders and dorsum. All the laminae have small secondary fissures, and the primary or interlaminar sulci are wide. All the fissures of the left organ run from below forwards and upwards, but those of the right lateral organ run forwards, upwards, or backwards. The measurements, laminae, and sulci are shown as follows:—

<i>Organ.</i>	<i>Length.</i>	<i>Laminae.</i>	<i>Sulci.</i>
Right	1.9 cm.	11	12
Left	1.8 ,,	10	11

The Inferior Papillary Zone.

The papillary bounding zone of the inferior surface is wide round the apex, but narrows as it is traced posteriorly. It is, in the former situation, closely dotted by small conical and fungiform papillæ.

Plicæ fimbriatæ are absent in my specimen.

The *mesial sulcus* is shallow and wide.

The *frenum* is long and lax.

The Frenal Lamella.

The lamella is triangular in shape, but the edges sweep round to the bifid apex, and the dividing fissure is deep. The edges also run back to below the middle of the lateral organs and are crenated or bear processes. The upper surface has a mesial longitudinal sulcus from which short, horizontal fissures pass out across the lamella.

THE ANUBIS BABOON (*P. anubis*).

Habitat: West Africa.

Measurements.—Total length 9.2 cm.; length of the oral part 6.6 cm.; length of the pharyngeal part 2.6 cm.; width between the lingual attachments of the palato-glossal folds 3 cm.; width of the anterior third 3.2 cm.

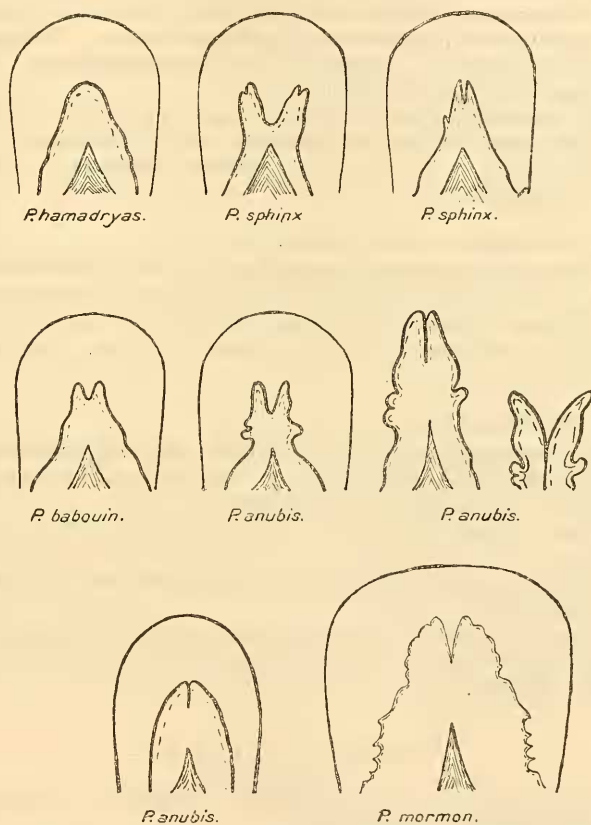
The *apex* has a mesial notch whence a *mesial dorsal sulcus* runs backwards for 2·3 cm. It has many fungiform papillæ.

The structures mentioned on page 278 are absent.

The Circumvallate Papillæ (text-fig. 34).

The vallate area consists of two anterior papillæ, and a mesial cluster of three small papillæ standing on a plane surface. The

Text-figure 36.



The frenal lamellæ of the Baboons*.

anterior papillæ are oval and retracted, the fossæ are clearly defined, and the vallums appear as prominent zones. All papillæ are smooth, but the vallums are granular.

* Several of the figures are reproduced from sketches lent to me by, Mr. R. I. Pocock.

The Fungiform Papillæ (text-fig. 35).

The fungiform papillæ have the usual arrangement, but the rows are maintained far forwards. They form a dorsal bounding zone on which they are numerous, but they are scanty on the ventral zone.

All are hemispherical, and smooth or granular. None are overlapped by conical papillæ.

The Conical Papillæ (text-fig. 35).

Arrangement.—Behind the apex there is a dense cluster, but behind this the papillæ are all in oblique chains. No transverse rows are present. Between them the interpapillary dorsum appears in the form of strips.

The papillary bodies are flat, conical, cylindrical or tuberoso, and they have one or more processes which are directed in the usual manner. They are not, however, arranged in zones as in *P. porcaricus*.

The Lateral Organs (text-fig. 34).

Small rounded lamellæ are separated by wide primary sulci, so the organs look like rows of small oval bodies. They lie entirely on the lateral borders. The right organ is 1.3 cm. long, and has 8 laminae and 9 sulci. The left organ is 1.2 cm. long, and has 10 laminae and 11 sulci.

The Frenal Lamella (text-fig. 36).

The triangular lamella has a rounded apex with a small fissure, but no transverse sulci are present on the upper surface. The edges have small tubercles posteriorly.

A few *orifices of ducts and pits* are present on the sides of the base.

The *mesial ventral sulcus* has a mesial crest, and the *frenum* is long and lax.

Flower (5) states that there is one posterior vallate papilla, but there may be small ones merging into fungiform papillæ, and the latter are large.

THE MANDRILL (*P. mormon*).

Münch (8) has pointed out how the tongue of *P. mormon* has a well-developed lateral organ.

In the specimen which I examined there are five vallate papillæ in the V-formation. The mesial papilla of each limb is small, the two anterior papillæ are large and round, and the posterior papilla, which is the largest of all, is oval (text-fig. 34).

The left lateral organ has seven laminae and eight sulci, and the right organ, whose ridges are all furrowed, has five laminae and six sulci.

The frenal lamella has a bifid apex, and the edges have long processes (text-fig. 36).

No plicæ fimbriatæ are present.

From the descriptions of different species of *Papio* described above, one can see that plicæ fimbriatæ are absent. Meckel, as reported by Oppel, found traces, however (17). As the mucosa of the under surface of the tongue is sometimes very lax in the Baboons, and thrown into small irregular folds, a false impression of the plicæ may be obtained.

SUMMARY.

1. The tongues of the Cercopithecidæ do not contain many pigmented forms, and those which are coloured vary in the distribution of the pigment. The tongue of *Cercopithecus patas* may be yellow or colourless.

2. The conical and fungiform papillæ, with few exceptions, exhibit the usual type of arrangement. Only in *Cercopithecus aethiops* was it different.

3. The vallate papillæ form a triangle, V, or double pair, but the pattern is not characteristic in any genus.

4. The lateral organs appear as rows of sulci and flat laminae, or as rows of oval or rod-like bodies.

5. The frenal lamella is entire or bifid, even in different examples of the same species, so it is not of value for purposes of classification.

6. The glands on the base of the tongue are largest in the Langurs, in which they occupy a large area. They are not very prominent in the Cercopithecines nor in the Macaques; in the former the duct orifices are larger than in the latter. In the Mangabeys and Baboons they form prominent masses with large orifices on the sides of the base of the tongue. These structures are, therefore, of the greatest value in classifying the tongues of the Cercopithecidæ.

7. Plicæ fimbriatæ, lytta, foramen cæcum, and Apical Gland of Nuhn or Blandin are absent in the adult tongue. Plicæ fimbriatæ may, however, be present in very young tongues.

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